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ACIDIC PRECIPITATION IN ONTARIO STUDY

MONITORING OF LAKE SUPERIOR TRIBUTARIES, 1980 - 81

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by

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SUMMARY

Between October 1980 and October 1981, sampling was conducted on 21 watercourses draining to Lake Superior between Sault Ste. Marie and Wawa. All waters studied showed reductions in pH, alkalinity and conductivity during the spring runoff period of 1981. Two waters showed pH minima of $\sim$5.0 and an additional five waters showed pH minima in the range of 5.5 to 6.0. Since most of these waters constitute valuable fishery resources, particularly for salmonids, the observed pH depressions prompt concern over possible effects on fish populations.

Investigation of point-in-time macroinvertebrate community structure in six selected streams showed no obvious relationships to stream pH regimes.

INTRODUCTION

Between October 9, 1980 and October 24, 1981, water quality investigations were carried out on streams and rivers draining to Lake Superior between Sault Ste. Marie and Wawa. Emphasis was placed on documenting the pH and alkalinity of these waters through the spring runoff period of 1981. Additional effort was devoted to collecting baseline data on macroinvertebrate communities in selected streams.

Work was focused on this region of Algoma because most of the watercourses involved consitute valuable fishery resources (particularly for salmonids) and limited previous sampling in 1979 (Keller, unpublished data) had suggested sensitivity to acidic precipitation. Many of these waters have historically supported spawning runs of rainbow trout (*Salmo gairdneri* Richardson) and resident populations of brook trout (*Salvelinus fontinalis* (Mitchill)). More recently, some have also become spawning grounds for introduced pacific salmon, including the coho (*Oncorhynchus kisutch* (Walbaum)), pink (*Oncorhynchus gorbuscha* (Walbaum)) and chinook (*Oncorhynchus tshawytscha* (Walbaum)).

The primary intent of the present report is to summarize the data collected during 1980-81, in order to provide a background data base available to future researchers.

METHODS

In total, 21 watercourses (Figure 1) were sampled between October 9, 1980 and October 24, 1981. The original study plan included only nine selected waters; however, additional sites were added as the study progressed. Thus, sampling intensity varied somewhat between sites. In most cases, sites were visited weekly from late March to early June and about monthly during other periods. During each visit, water samples were collected at the same point slightly upstream of the Highway 17 crossing in clean, sample-rinsed 500 ml polystyrene bottles for analyses of pH, alkalinity, (total inflection point) and conductivity. Analyses were completed at the Sudbury M.O.E. laboratory on the day following collection (after overnight refrigeration). At the nine waters originally slated for intensive study (Figure 1), temperature and water level were also measured. Water level was taken by measurement from a specific measuring point on a bridge or culvert to the water surface. Stream depth was estimated from water level measurements by comparison with depth at a known stage height. Samples for major ion (one litre glass bottles) and total trace metal analyses (500 ml acid washed polyethylene bottles; HNO_3 preserved) were collected at least seasonally from the nine intensively sampled watercourses and some of the other waters were sampled less frequently. Major ion and trace metal determinations were conducted at the M.O.E. laboratory in Toronto, following procedures outlined in M.O.E. (1981).

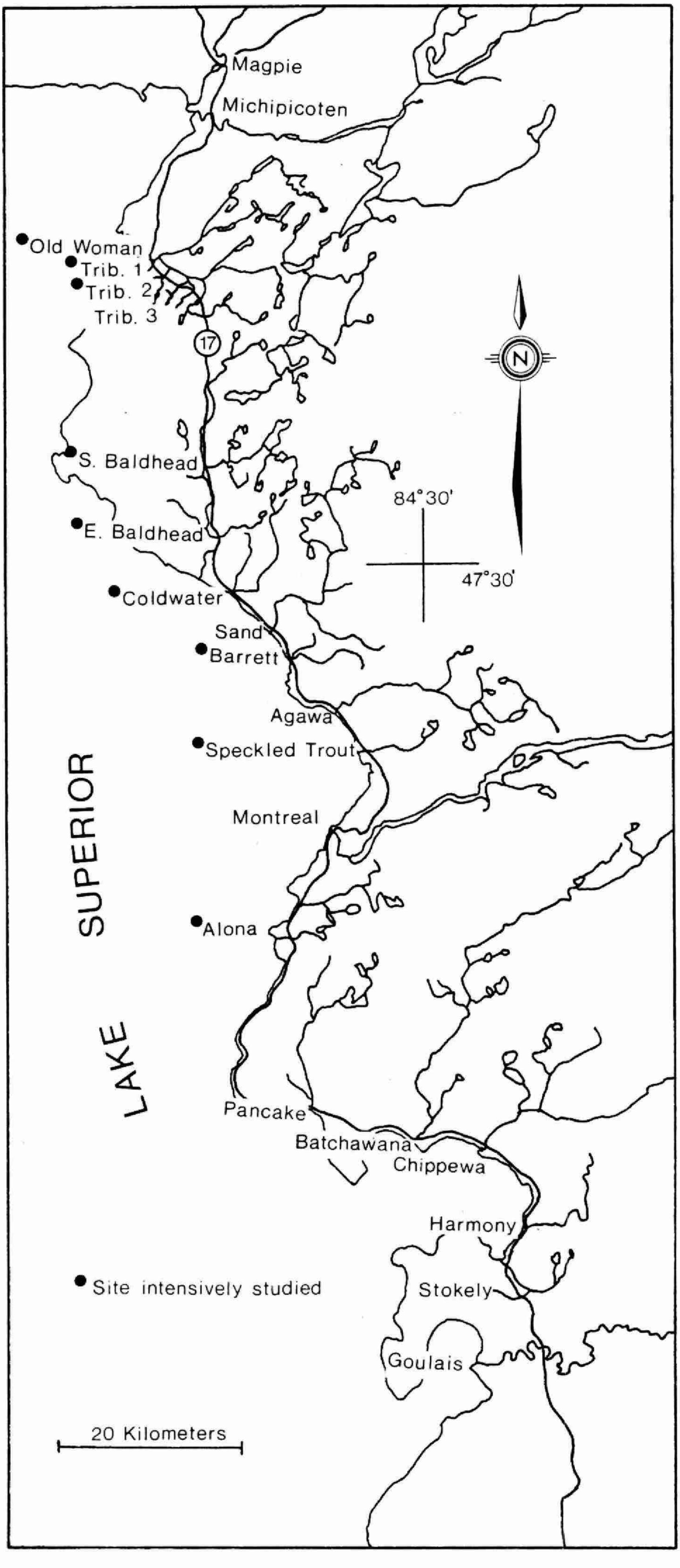

Figure 1:

The Study Area

During June 22 to 26, 1981, benthic invertebrate communities were sampled in six selected streams (Barrett River, Speckled Trout Creek, South Baldhead River, Coldwater River, East Baldhead River and Alona Creek) spanning a range in observed pH. At five of the streams, sampling consisted of six 929 cm^2 Surber samples (riffle areas) and one hour of qualitative collection with a hand sieve (other aquatic habitats). Due to a scarcity of suitable riffles only three surber samples were collected from the remaining stream (South Baldhead) in addition to 1 1/2 hours of qualitative sampling. With the exception of the Coldwater River which had a predominantly rock and sand bottom and comparatively low stream velocity, all Surber sampling sites were physically similar, fast-flowing coarse gravel riffles.

Invertebrates collected were preserved in 70% ethanol for subsequent identification and enumeration at the Sudbury M.O.E. laboratory. Identifications followed Harper and Hynes (1971), Edmunds et al (1976), Pennak (1978) and Wiggins (1978).

RESULTS AND DISCUSSION

Chemistry in Relation to Fish Populations

The results of individual analyses are provided in Tables A1 and A2 of the Appendix. A summary of observed ranges in pH, alkalinity, and conductivity is given in Table 1. Recorded minima for these parameters were associated with high spring flows while maxima were associated with low flow periods, primarily in late summer. All watercourses, even those with high buffering capacity during most sampling periods, showed substantial reductions in pH, alkalinity and conductivity during spring runoff. Correspondingly, in those streams with seasonally collected data, lowest concentrations of most major ions (Table 2) were observed in spring, reflecting the influence of dilute runoff water.

In most waters the degree of pH depression observed was not extreme (ie. 14 watercourses did not show pH <6.0); however, two sites (Speckled Trout Creek and Barrett River exhibited low minimum pH (5.09 and 5.00 respectively) and an additional five sites showed pH minima in the range of 5.5 to 6.0 (Table 1). It should be noted that snow accumulation during the winter of 1980-81 (as observed during sampling visits) was not high, thus the spring melt period of 1981 may not reflect worst case conditions.

Table 1 - Ranges in pH, alkalinity (total inflection point) and conductivity in Lake Superior tributaries (October 1980 - October 1981)

Watercourse (n)	pH	Alkalinity (mg/L as $CaCO_3$)	Conductivity (µS/cm)
Agawa River (14)	5.77-7.32	0.69-20.12	25-62
Alona Creek (16)	6.64-7.60	5.25-27.24	33-76
Barrett River (17)	5.00-6.76	-0.50-6.83	24-52
Batchawana River (10)	6.50-7.48	3.81-25.53	32-53
Chippewa River (12)	6.85-7.57	6.80-23.84	38-57
Coldwater River (17)	5.74-7.25	0.49-10.77	27-66
East Baldhead River (17)	5.98-6.90	1.00-5.16	27-37
Goulais River (11)	6.82-7.40	6.01-26.58	39-82
Harmony River (12)	6.16-7.24	1.59-16.22	29-82
Magpie River (11)	7.21-8.05	25.61-65.36	42-223
Michipicoten River (12)	6.92-7.52	11.18-29.40	52-90
Montreal River (12)	6.81-7.28	12.88-23.96	52-72
Old Woman River (15)	6.54-7.44	5.44-25.80	41-122
Old Woman Tributary #1 (15)	6.57-7.12	4.18-12.32	37-114
Old Woman Tributary #2 (16)	6.54-7.42	3.63-26.17	37-121
Old Woman Tributary #3 (11)	6.25-6.81	2.56-21.53	39-81
Pancake River (12)	6.65-7.25	5.64-17.61	37-90
Sand River (14)	5.57-7.30	0.33-11.65	27-48
South Baldhead River (17)	5.71-7.17	0.95-18.09	34-110
Speckled Trout Creek (18)	5.09-7.20	-0.35-11.88	24-56
Stokely Creek (9)	6.76-7.54	6.70-49.05	52-126

Table 2 - Ranges in concentrations of major ions, turbidity, colour and total concentrations of trace metals in selected Lake Superior tributaries for data collected at least seasonally (1980-1981)

	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO_4 (mg/L)	Cl (mg/L)	Turb.(Formazin)	Color (Hazen)
Alona	4.4-9.0	0.95-2.25	0.9-1.6	0.50-0.75	6.5-8.0	0.30-0.95	0.45-3.50	15.0-65.7
Barrett	1.8-3.4	0.40-0.95	0.6-2.8	0.30-0.45	6.5-8.5	0.25-3.60	0.29-1.10	13.0-38
Coldwater	2.2-5.8	0.45-1.45	0.6-1.4	0.35-0.60	6.5-9.5	0.05-0.80	0.25-1.00	17.1-24.6
E. Baldhead	2.4-3.8	0.40-0.75	0.5-0.8	0.25-0.40	6.0-6.5	0.20-0.35	0.32-0.70	12.1-22.0
Old Woman	4.6-9.8	0.80-2.05	0.9-2.6	0.50-0.80	7.5-3.75	0.75-3.75	0.36-1.50	13.0-38.0
Tributary #1	4.8-7.0	0.85-1.20	0.5-1.2	0.40-0.50	10.0-12.0	0.25-0.40	0.18-0.60	6.7-72.0
Tributary #2	4.6-11.8	0.60-2.40	0.5-1.80	0.45-1.00	9.5-12.0	0.35-1.30	0.15-0.60	9.4-31.0
S. Baldhead	3.2-9.2	0.35-1.70	1.3-7.5	0.35-0.65	7.0-9.0	1.70-14.5	0.40-1.50	18.4-63.0
Speckled Trout	1.6-5.4	0.40-1.45	0.6-1.8	0.30-0.55	6.0-8.5	0.30-1.50	0.28-1.50	4.0-22.9

	Tot. Cu (μg/L)	Tot. Ni (μg/L)	Tot. Zn (μg/L)	Tot. Al (μg/L)	Tot. Mn (μg/L)	Tot. Fe (μg.L)
Alona	<1-1	<0.5-<2	<1-6	50-270	12-18	130-270
Barrett	0-2	0.8-<2	3-11	100-760	12-168	40-1120
Coldwater	<1-3	<1-<3	3-20	67-540	6-50	33-1260
E. Baldhead	0-2	<0.5-<3	2-21	35-180	6-22	34-90
Old Woman	<1-2	<0.5-<3	<1-4	45-290	6-20	50-300
Tributary #1	<1-6	<0.5-<2	<1-1	61-140	4-14	<10-40
Tributary #2	0-1	<0.5-<3	<1-1	39-150	6-12	<10-40
S. Baldhead	0-3	0.5-<3	1-21	69-190	10-36	60-250
Speckled Trout	0-2	<0.5-<3	<1-12	34-260	12-51	40-100

Although the weekly sampling format employed does not provide a temporally complete picture (ie. conditions more acidic than recorded could have occurred between sampling events) it is interesting to observe the apparent pattern of pH depression in the two most seriously affected waters. Both Speckled Trout Creek and the Barrett River showed substantial reductions in pH for a period of at least two weeks (April 2 to April 14, 1981) after the onset of substantial snowmelt (Figure 2). Following the period of major melt, pH increased for several weeks until heavy rains in early May resulted in a second period of pH depression. Data on pH for two consecutive days during that period are available only for Speckled Trout Creek (May 5 and 6, 1981) but it was observed that pH increased from 5.39 to 5.59 as streamflow decreased following the end of a heavy rainstorm (Figure 2).

The potential impact of spring pH depression on fish populations in Algoma waters is difficult to estimate since *in situ* fish responses to low pH are poorly defined. A particularly important aspect to consider is the timing of reproductive activity in relation to observed pH depressions. Rainbow trout in general seem particularly sensitive to acid stress (Grande *et. al.* 1978). However, since they are spring spawners with hatching and emergence usually occurring in late spring (Scott and Crossman 1973) the highly vulnerable life stages (sac fry, swim-up alevins)

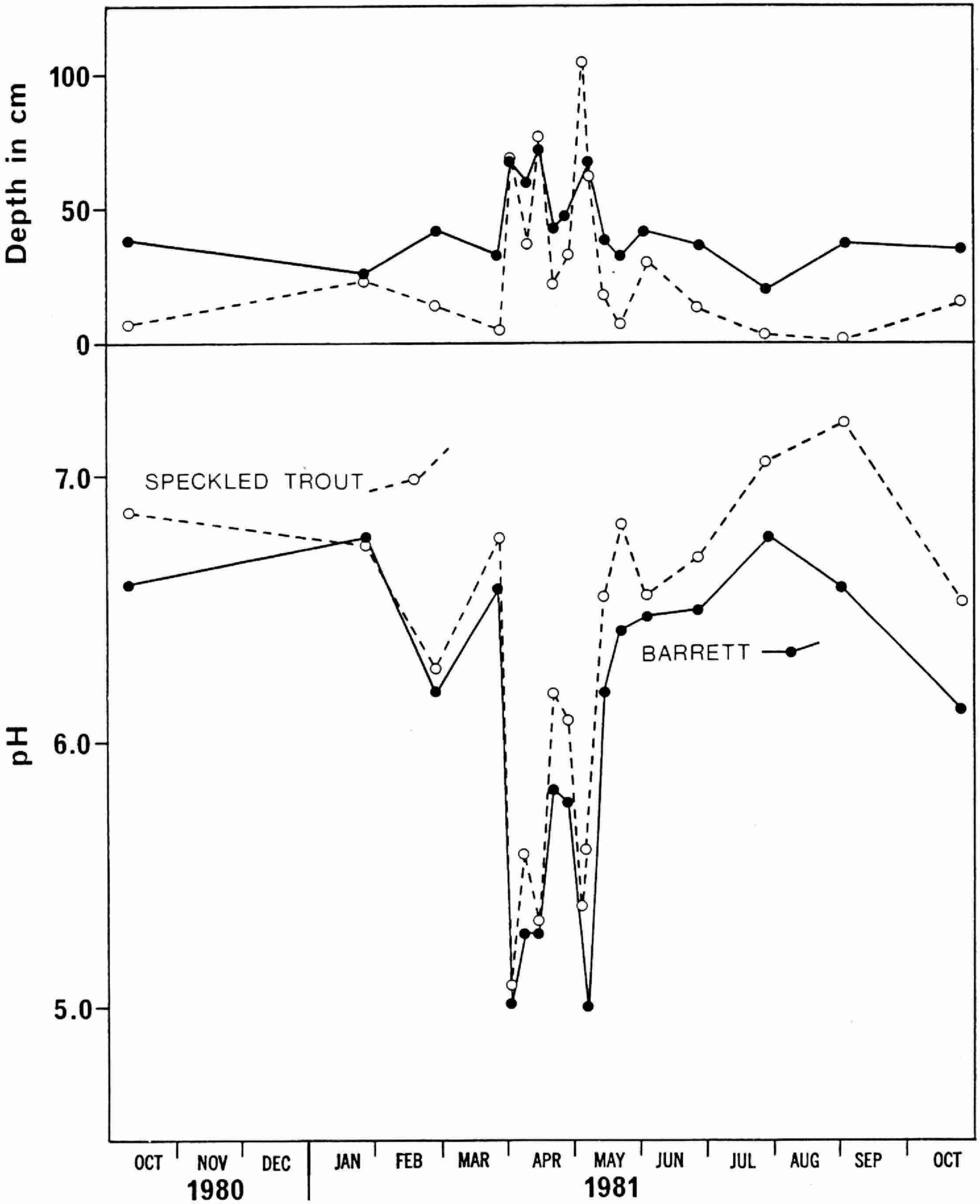

Figure 2: Temporal variation in pH and stream depth in Speckled Trout Creek and the Barrett River, 1980-81.

may not occur until after worst conditions (from a pH viewpoint) which seem to occur in late April to early May have passed. Brook trout are regarded as one of the salmonids more tolerant to low pH (Grande et. al. 1978); however, due to behavior (ie. fall spawning, hatching and alevin emergence in late winter/early spring) the most sensitive stages may coincide with worst case water quality. Fall-spawning pacific salmon may be similarly susceptible.

Elevated concentrations of Al in some of the waters studied (Table 2) constitute a further area of concern relative to potential impacts on fish populations. Aluminum has been strongly implicated in fish mortalities under acidic conditons (Baker and Schofield 1980, Grahn 1980, Muniz and Lievestad 1980), with maximum Al toxicity appearing at around pH 5.0. Speckled Trout Creek and the Barrett River showed total Al concentration $\geq$ 200 ug/L at pH near 5.0, however, the form of Al in these waters and thus the true potential for fish toxicity is not known. The speciation of Al in aquatic environments seems much more related to fish toxicity than total Al concentrations (Baker and Schofield 1980).

Macroinvertebrate Communities

A taxa list based on invertebrate collections in six selected watercourses is given in Table A3 of the Appendix. A summary of selected aspects of the macroinvertebrate data is provided in Table 3.

Based on Jaccard Coefficients, a measure of community similarity, benthic invertebrate communities showed wide variation between streams (Table 3). Only two streams, the Barrett and South Baldhead Rivers yielded a coefficient of community >0.50. Based on Surber collections, from 11 to 30 taxa were found per stream and average density of individuals ranged from 88 to 1091 animals/m^2. From 3 to 18 additional taxa per stream were collected in qualitative samples.

Although communities varied widely between streams, no dramatic changes in composition based on taxonomic (Table 3) or functional (Figure 3) groupings were apparent when streams were arranged in order of minimum observed pH. Speckled Trout Creek and the Coldwater River exhibited the lowest invertebrate densities and lowest numbers of taxa in Surber samples. In the case of the Coldwater River the results may reflect less than ideal conditions for Surber sampling (largely sandy substrate and low stream velocity) leading to poor sampling efficiency. In all other streams

Table 3 - Summary of data on macroinvertebrate communities in six selected Lake Superior tributaries based on collections in June 1981.

	Barrett (pH 5.00- 6.76)	Speckled Trout (pH 5.09-7.20)	South Baldhead (pH 5.71-7.17)	Coldwater (pH 5.74-7.25)	East Baldhead (pH 5.98-6.90)	Alona (pH 6.64-7.60)
No. of taxa						
Surber samples	26	11	30	11	26	18
Qualitative samples	11	14	18	13	11	3
Total	37	25	48	24	37	21
Individuals/m^2 (surbers)	355	111	1091	88	465	188
% composition						
Ephemeroptera	34	6	20	20	49	28
Plecoptera	11	16	5	8	6	1
Trichoptera	10	3	35	6	15	11
Diptera	40	66	36	35	7	19
Oligochaeta	3	6	1	2	4	28
Others	2	2	3	2	19	13
Jaccard Coefficient (Surbers)						
Barrett	1.00	0.22	0.68	0.31	0.26	0.31
Speckled Trout	-	1.00	0.20	0.35	0.11	0.26
South Baldhead	-	-	1.00	0.38	0.36	0.31
Coldwater	-	-	-	1.00	0.27	0.35
East Baldhead	-	-	-	-	1.00	0.29
Alona	-	-	-	-	-	1.00

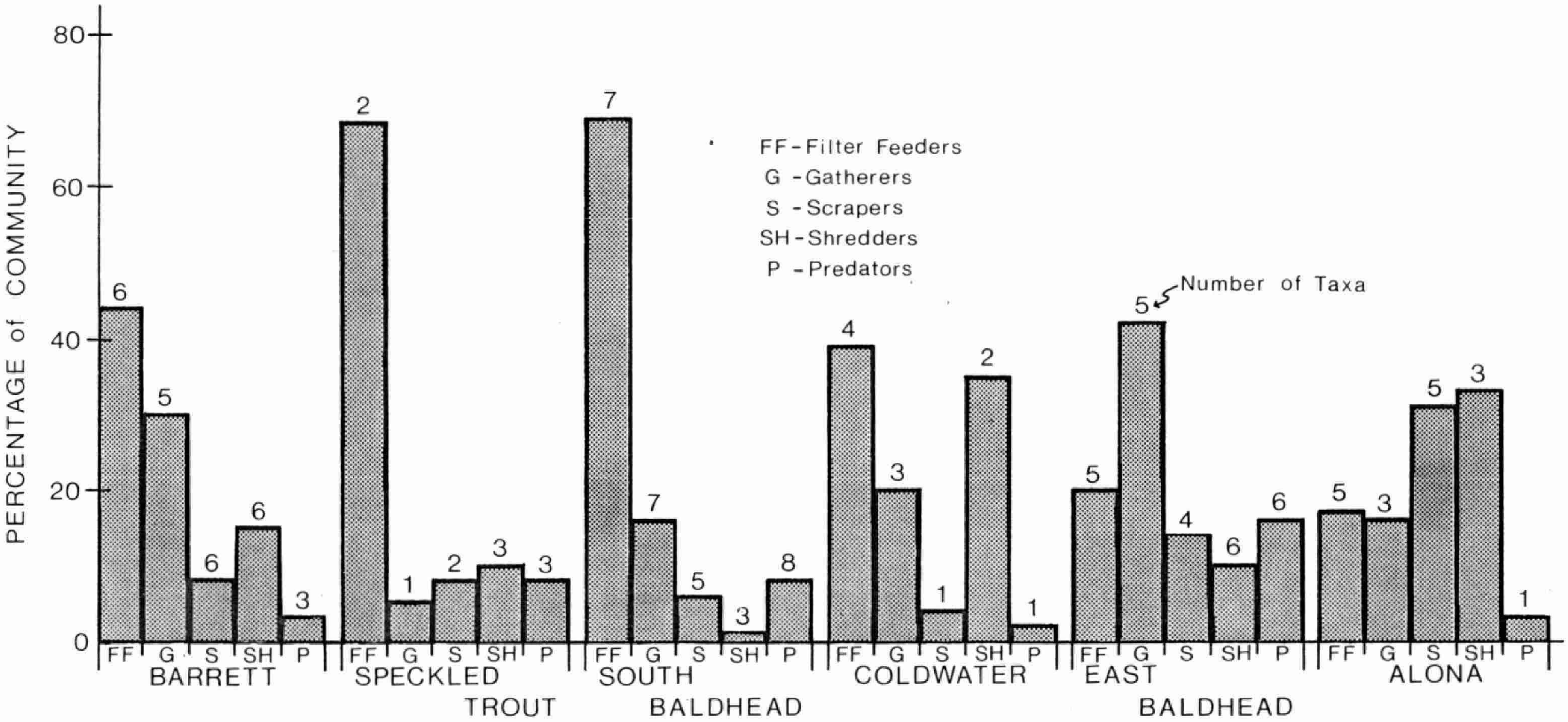

Figure 3: Percent composition of invertebrate communities by functional groups (groups after Merritt and Cummins, 1978) in six selected Lake Superior tributaries, June 1981.

Surber sampling was conducted in representative, physically comparable, gravel riffle areas. It is tempting to ascribe the low (relative to the other waters) invertebrate abundance and diversity in Speckled Trout Creek to the low pH observed (minimum recorded 5.09). However, the high relative abundance of Ephemeroptera, which seem highly sensitive to low pH (Bell 1971) and have been reported as absent or scarce in acidic environments (Friberg et. al. 1980; Harriman and Morrison 1980), in the Barrett River which had similarly low pH (minimum recorded 5.00) makes this a tenuous assumption.

It appears that in these streams, no obvious direct relationships between pH and macroinvertebrate communities are reflected by general point-in-time community composition in early summer. This does not indicate that more subtle changes in response to acidity are not occurring, only that a simple community investigation may not reveal such alterations over the range in pH regimes present in these streams. It should be borne in mind that the influences of other factors including variable emergence times and fish predation are not known in these waters.

As pointed out in relation to fish, it is very difficult to directly relate minimum observed pH to potential biological effects since the duration and timing of pH depression relative to animal life stages may be of prime importance.

Bell (1971) reported 30-day TL50 pH's of 2.45 to 5.38 for 9 species of aquatic insects while mean 96 hour TL50 pH's for the same species ranged from 1.5 to 4.65 (Bell and Nebecker 1969). The period of emergence appears to be a particularly pH sensitive stage for aquatic insects (Bell 1971).

CONCLUSIONS

Sampling of Lake Superior tributaries during 1980-81 demonstrated that at least some lotic environments in the District of Algoma are subjected to substantial pH depression associated with snowmelt and spring rains, similar to observations in south-central Ontario (Jeffries et. al. 1979). Although macroinvertebrate communities in selected streams showed no obvious relationship to observed pH, and adverse effects on fish populations in the area have not been documented, concern over possible influences on biota is warranted since these waters exhibit generally high sensitivity to acidic inputs and most constitute valuable fishery resources.

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APPENDIX

TABLE A1	Results of pH, TIA (total inflection point alkalinity), conductivity, temperature and depth measurements, Lake Superior tributaries, 1980-81.
TABLE A2	Results of major ion, colour, turbidity, and total trace metal analyses, Lake Superior tributaries, 1980-81.
TABLE A3	Total invertebrate taxa lists from Lake Superior tributaries, 1981.

TABLE A1 Results of pH, TIA (total inflection point alkalinity), conductivity, temperature, and depth measurements, Lake Superior tributaries, 1980-81.

WATERCOURSE (Sampling Date)	pH	TIA (mg/L)	Conductivity (µs/cm)	Temperature (°C)	Depth (cm)
Agawa River					
9/10/80	6.92	5.80	35		
24/3/81	6.98	8.72	42		
2/4/81	5.90	1.05	31		
9/4/81	5.94	1.29	32		
14/4/81	5.77	0.69	26		
22/4/81	6.23	1.89	28		
29/4/81	6.27	2.07	28		
6/5/81	5.82	0.82	25		
13/5/81	6.54	3.57	31		
20/5/81	6.81	6.13	36		
3/6/81	7.01	8.25	39		
25/6/81	6.88	7.28	37		
28/7/81	7.30	16.43	56		
1/9/81	7.32	20.12	62		
Alona Creek					
9/10/80	7.58	24.82	73	5.5	22
28/1/81	7.40	25.11	74	-1.0	24
27/2/81	7.28	18.44	62	0.0	22
25/3/81	7.43	23.08	72	2.0	24
2/4/81	6.68	5.57	39	1.0	43
9/4/81	6.75	6.41	38	1.8	38
14/4/81	6.64	5.25	33	2.5	53
22/4/81	7.12	11.77	46	3.2	28
29/4/81	7.13	13.03	52	4.9	26
6/5/81	6.91	8.10	38	6.5	38
13/5/81	7.20	14.70	55	6.0	26
20/5/81	7.36	19.10	61	10.0	24
3/6/81	7.26	15.24	52	11.5	31
25/6/81	7.13	12.57	46	9.8	25
28/7/81	7.60	24.52	72	11.9	19
11/9/81	7.51	27.24	76	14.6	18
Barrett River					
9/10/80	6.60	2.90	35	4.0	37
28/1/81	6.75	6.83	52	-1.0	26
27/2/81	6.19	1.61	38	0.0	43
25/3/81	6.59	4.12	41	0.5	32
2/4/81	5.02	-0.44	32	1.0	68
9/4/81	5.27	-0.17	29	1.2	60
14/4/81	5.27	-0.18	27	1.8	72
22/4/81	5.83	0.59	30	2.9	41
29/4/81	5.77	0.48	28	4.0	47
6/5/81	5.00	-0.50	24	6.0	66
13/5/81	6.19	1.48	32	5.3	38
20/5/81	6.43	2.82	38	8.3	34
3/6/81	6.48	2.78	34	11.0	41
25/6/81	6.50	2.61	31	10.0	36
28/7/81	6.76	5.99	47	17.2	20
1/9/81	6.58	4.66	40	15.7	37
24/10/81	6.11	1.45	31	2.0	35
Batchawana River					
9/10/80	7.15	13.50	53		
2/4/81	6.50	3.81	36		
14/4/81	6.57	4.07	32		
22/4/81	6.75	6.48	40		
29/4/81	6.75	7.08	40		
13/5/81	6.88	8.65	42		
3/6/81	7.24	13.84	52		
25/6/81	7.08	11.02	44		
28/7/81	7.43	21.19	68		
1/9/81	7.48	25.53	75		
Chippewa River					
9/10/80	7.32	13.81	52		
24/3/81	7.07	13.66	57		
2/4/81	6.95	8.22	46		
9/4/81	6.90	7.70	42		
14/4/81	6.85	6.80	38		
22/4/81	6.94	9.14	42		
29/4/81	7.04	9.14	43		
13/5/81	7.05	10.04	45		
3/6/81	7.25	15.26	54		
25/6/81	7.14	8.99	39		
28/7/81	7.57	19.32	62		
1/9/81	7.44	23.84	72		
Coldwater River					
9/10/80	6.87	5.77	39	4.5	41
28/1/81	6.99	10.61	66	-0.5	ice
27/2/81	6.49	3.26	37	0.0	ice
25/3/81	6.84	6.58	43	0.0	ice
2/4/81	5.88	0.69	33	1.0	66
9/4/81	5.81	0.60	32	1.0	50
14/4/81	5.75	0.49	27	1.8	72
22/4/81	6.19	1.35	30	2.7	31
29/4/81	6.43	2.33	31	4.5	32
6/5/81	5.74	0.51	28	6.0	74
13/5/81	6.50	2.89	34	6.0	30
20/5/81	6.82	5.13	38	7.8	25
3/6/81	6.84	5.73	38	11.0	25
25/6/81	6.77	4.75	35	10.2	26
28/7/81	7.25	10.21	49	12.2	18
1/9/81	6.93	10.77	51	12.6	29
24/10/81	6.52	2.87	32	2.0	29
East Baldhead River					
9/10/81	6.64	2.97	30	5.5	36
28/1/81	6.62	4.06	33	-1.0	ice
27/2/81	6.36	2.30	32	0.0	ice
25/3/81	6.56	3.28	34	0.0	ice
2/4/81	6.23	1.68	32	1.5	73
9/4/81	6.16	1.51	31	1.6	61
14/4/81	5.98	1.00	28	1.3	85
22/4/81	6.20	1.35	28	2.2	49
29/4/81	6.16	1.31	28	2.8	47
6/5/81	6.17	1.41	27	4.0	96
13/5/81	6.29	1.59	28	4.9	41
20/5/81	6.54	2.47	29	10.2	33
3/6/81	6.63	3.14	30	13.5	31
25/6/81	6.62	2.91	29	12.9	30
28/7/81	6.90	4.40	33	17.2	19
1/9/81	6.74	5.16	37	17.8	23
24/10/81	6.52	2.35	31	4.0	40
Goulais River					
9/10/80	6.28	-	53		
2/4/81	7.36	12.54	49		
9/4/81	6.95	6.92	43		
14/4/81	6.82	6.01	40		
22/4/81	6.89	6.52	39		
29/4/81	6.84	7.54	42		
13/5/81	6.86	7.78	44		
3/6/81	6.90	8.56	46		
25/6/81	7.20	13.26	54		
28/7/81	7.05	10.01	45		
1/9/81	7.40	26.58	82		
Harmony River					
9/10/80	6.97	7.10	44		
24/3/81	6.81	6.65	47		
2/4/81	6.16	1.59	34		
9/4/81	6.26	1.61	32		
14/4/81	6.25	1.61	29		
22/4/81	6.57	3.60	35		
29/4/81	6.67	3.90	36		
13/5/81	6.72	4.74	39		
3/6/81	6.97	7.31	42		
25/6/81	6.86	5.51	35		
28/7/81	7.23	12.95	69		
1/9/81	7.24	16.22	82		
Magpie River					
9/10/80	7.75	44.72	43		
24/3/81	7.55	44.93	157		
2/4/81	7.46	34.10	128		
9/4/81	7.21	35.78	42		
14/4/81	7.28	32.01	120		
22/4/81	7.32	25.61	88		
29/4/81	7.39	28.93	103		
13/5/81	7.49	26.23	87		
25/6/81	7.68	42.20	127		
28/7/81	8.05	56.61	191		
1/9/81	8.02	65.36	223		

TABLE A1 (Continued)

WATERCOURSE

Michipicoten River

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	7.52	23.10	74		
24/3/81	7.50	29.40	90		
2/4/81	7.34	26.46	83		
9/4/81	7.15	20.23	68		
14/4/81	7.11	16.09	61		
22/4/81	6.99	11.45	52		
29/4/81	6.92	11.47	54		
13/5/81	7.01	11.18	53		
3/6/81	7.19	17.31	60		
25/6/81	7.25	18.51	65		
28/7/81	7.41	20.79	72		
1/9/81	7.50	25.25	78		

Montreal River

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	7.28	15.56	54		
24/3/81	6.97	23.75	72		
2/4/81	6.97	23.96	70		
9/4/81	6.86	22.00	70		
14/4/81	6.94	17.80	60		
22/4/81	6.81	14.03	52		
29/4/81	6.81	12.88	52		
13/5/81	6.99	14.31	53		
3/6/81	6.95	15.21	53		
25/6/81	6.90	13.17	48		
28/7/81	6.90	13.12	49		
1/9/81	6.98	15.03	54		

Old Woman River

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	7.31	15.70	64	4.5	20
28/1/81	7.18	20.08	75	-0.5	ice
27/2/81	7.09	15.30	72	0.0	34
25/3/81	7.23	17.25	72	0.5	15
2/4/81	6.70	6.45	54	1.0	49
9/4/81	6.71	6.92	52	1.2	38
14/4/81	6.54	5.44	45	2.0	65
22/4/81	6.85	7.87	47	3.0	31
29/4/81	6.81	7.93	49	4.2	32
6/5/81	6.65	5.59	41	4.5	83
13/5/81	6.98	8.97	53	6.0	32
20/5/81	7.09	12.69	60	9.5	-
3/6/81	7.16	15.19	65	12.5	25
25/6/81	7.27	17.42	70	11.2	18
28/7/81	7.44	21.59	81	14.8	7
1/9/81	7.41	25.80	91	16.0	9
24/10/81	7.19	15.06	122	3.0	19

Old Woman Tributary #1

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	7.12	12.32	59	1.5	6
27/2/81	6.85	7.96	56	-1.0	ice
2/4/81	6.64	4.59	42	0.0	21
9/4/81	6.73	5.78	43	0.3	15
14/4/81	6.57	4.18	37	0.5	25
22/4/81	6.76	6.22	43	1.2	11
29/4/81	6.79	6.36	44	2.5	13
6/5/81	6.61	4.59	40	2.5	18
13/5/81	6.89	7.81	49	3.8	12
20/5/81	6.94	10.67	55	4.0	10
3/6/81	7.00	11.78	58	6.5	11
25/6/81	7.03	11.39	56	7.1	7
28/7/81	7.05	11.12	60	9.4	5
1/9/81	7.00	11.49	60	7.4	11
24/10/81	7.04	9.50	114	1.5	9

Old Woman Tributary #2

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	7.37	17.64	69	3.0	9
28/1/81	7.35	26.17	90	-1.0	ice
27/2/81	6.92	9.72	69	-1.0	ice
2/4/81	6.70	5.32	48	0.0	ice
9/4/81	6.83	8.00	58	0.5	ice
14/4/81	6.54	3.63	37	0.2	ice
22/4/81	6.97	8.31	50	0.3	8
29/4/81	6.71	6.83	47	2.5	11
6/5/81	6.61	4.76	41	2.0	17
13/5/81	6.93	8.71	54	2.3	10
20/5/81	7.15	12.61	58	3.6	8
3/6/81	7.25	15.78	65	7.5	8
25/6/81	7.25	16.20	65	8.0	6
28/7/81	7.35	25.51	88	10.8	4
1/9/81	7.42	31.39	98	13.5	6
24/10/81	7.18	12.22	121	1.5	-

Stokely Creek

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	7.54	29.26	92		
24/3/81	7.33	22.42	102		
2/4/81	6.76	6.70	52		
22/4/81	7.07	14.85	66		
29/4/81	7.20	14.96	68		

Old Woman Tributary #3

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	6.75	11.86	62		
28/1/81	6.67	14.33	68		
2/4/81	6.26	2.81	52		
9/4/81	6.43	4.59	54		
14/4/81	6.25	2.56	39		
22/4/81	6.53	5.54	54		
29/4/81	6.41	4.30	47		
13/5/81	6.68	7.00	54		
3/6/81	6.76	11.42	66		
25/6/81	6.81	13.37	72		
1/9/81	6.81	21.53	81		

Pancake River

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	7.20	13.66	48		
24/3/81	7.00	14.53	90		
2/4/81	6.79	7.12	41		
9/4/81	6.65	5.64	38		
14/4/81	6.84	7.23	37		
22/4/81	6.82	7.35	39		
29/4/81	6.84	7.41	40		
13/5/81	6.93	8.78	45		
3/6/81	7.25	17.02	62		
25/6/81	7.07	10.96	44		
28/7/81	7.13	14.61	53		
1/9/81	7.08	17.61	62		

Sand River

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	6.92	5.07	35		
24/3/81	6.90	7.11	43		
2/4/81	5.82	0.68	33		
9/4/81	5.98	0.87	31		
14/4/81	5.78	0.47	28		
22/4/81	6.23	1.51	30		
29/4/81	6.22	1.61	31		
6/5/81	5.57	0.33	27		
13/5/81	6.48	2.62	32		
20/5/81	6.76	4.72	37		
3/6/81	7.07	6.63	38		
25/6/81	6.94	5.93	36		
28/7/81	7.30	10.90	48		
1/9/81	7.15	11.65	47		

South Baldhead River

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	6.80	7.99	53	4.5	46
28/1/81	6.89	16.88	88	-1.0	ice
27/2/81	6.60	9.60	66	-	ice
25/3/81	6.78	12.70	80	0.0	ice
2/4/81	6.12	2.88	44	0.5	82
9/4/81	5.98	2.31	41	0.5	64
14/4/81	5.86	1.30	36	1.0	78
22/4/81	6.17	2.98	42	2.5	58
29/4/81	6.34	3.39	41	3.8	61
6/5/81	5.71	0.95	34	5.0	127
13/5/81	6.62	5.57	53	6.5	51
20/5/81	6.78	8.21	59	11.0	46
3/6/81	7.05	12.62	76	15.0	42
25/6/81	6.96	11.09	66	13.8	41
28/7/81	7.17	15.25	86	18.0	33
1/9/81	7.12	18.09	110	18.3	37
24/10/81	6.66	6.97	58	2.0	45

Speckled Trout Creek

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
9/10/80	6.86	5.87	38	6.5	6
28/1/81	6.76	9.42	49	-1.0	24
27/2/81	6.27	1.92	32	0.0	14
25/3/81	6.76	5.68	42	1.5	5
2/4/81	5.09	-0.35	29	1.5	69
9/4/81	5.58	0.12	29	2.0	37
14/4/81	5.32	-0.07	25	1.5	77
22/4/81	6.18	1.76	30	2.5	21
29/4/81	6.09	1.24	28	3.9	33
5/5/81*heavy rain	5.39	-0.02	25	5.5	105
6/5/81	5.59	0.16	24	6.5	62
13/5/81	6.55	3.73	35	5.2	16
20/5/81	6.83	6.43	41	9.6	6
3/6/81	6.55	3.36	35	11.0	30
25/6/81	6.65	4.18	34	9.8	14
28/7/81	7.05	11.41	56	11.1	3
1/9/81	7.20	11.88	54	13.1	1
24/10/81	6.54	2.82	30	3.0	15

Stokely Creek (continued)

(Sampling Date)	pH	TIA (mg/L)	Conductivity (us/cm)	Temperature (°C)	Depth (cm)
13/5/81	7.19	15.26	66		
25/6/81	7.38	21.09	76		
28/7/81	7.53	41.07	126		
1/9/81	7.52	49.05	43		

TABLE A2

Results of major ion, colour, turbidity and total trace metal analyses
Lake Superior tributaries, 1980-81

WATERCOURSE (Sampling Date)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO_4 (mg/L)	Cl (mg/L)	NO_3 (mg/L)	Colour (Hazen)	Turb. (Formazin)	Cu (ug/L)	Ni (ug/L)	Zn (ug/L)	Al (ug/L)	Mn (ug/L)	Fe (ug/L)
Agawa River															
24/3/81	4.2	1.00	1.0	0.35	7.5	0.40	0.364	28	0.49	<1	<3	13	120	9	150
22/4/81	2.4	0.55	0.7	0.35	7.0	0.25	0.355	27.9	1.00	<1	<2	6	200	26	80
28/7/81	6.0	1.50	1.0	0.55	6.5	0.70	0.105	17.5	0.41	6	10	3	66	8	50
1/9/81	7.4	1.80	1.2	0.60	6.5	0.80	0.145	7.2	0.35	1	1	2	39	6	40
Alona Creek															
9/10/80	8.2	2.00	1.6	0.70	8.0	0.95	0.384	40	0.45	<1	<2	1	10	10	130
25/3/81	7.4	1.85	1.6	0.65	7.0	0.45	0.443	15	0.56						
22/4/81	4.6	1.05	1.1	0.50	7.0	0.35	0.350	22.9	1.30	<1	<1	6	150	14	160
6/5/81	4.4	0.95	0.9	0.55	7.5	0.30	0.265	65.7	3.50	<1	<2	3	270	18	270
28/7/81	8.0	2.00	1.4	0.65	6.5	0.55	0.370	24.7	0.96	1	<0.5	1	50	12	230
1/9/81	9.0	2.25	1.6	0.75	7.0	0.55	0.385	26.1	0.68	1	<1	1	55	12	230
Barrett Creek															
9/10/80	2.6	0.70	1.3	0.35	8.5	1.45	0.198	38	0.32	1	<2	4	220	8	120
25/3/81	3.2	0.90	1.7	0.40	8.0	1.45	0.633	21	0.32						
9/4/81										2	<2	11	200	50	66
22/4/81	2.2	0.50	1.3	0.30	7.0	1.20	0.510	18.4	1.10	<1	<2	10	200	32	40
6/5/81	1.8	0.40	0.6	0.35	6.5	0.25	0.320	33.3	0.78	<1	<2	9	190	46	70
28/7/81	3.4	0.95	2.8	0.45	7.0	3.60	0.265	26.5	0.29	0	0.8	3	100	12	90
1/9/81	3.0	0.85	2.4	0.45	6.5	2.60	0.240	13.0	0.59	2	1	11	760	168	1120
Batchawana River															
22/4/81	4.0	0.75	1.2	0.30	7.5	1.05	0.330	35.0	1.50	<1	<2	3	150	20	140
Chippewa River															
24/3/81	6.6	1.35	1.2	0.35	8.0	0.70	0.389	25	2.3	<1	<3	5	160	15	270
Coldwater River															
9/10/80	3.8	0.90	0.9	0.35	8.5	0.45	0.258	27	0.25	<1	<2	3	160	10	140
25/3/81	4.4	1.15	1.1	0.45	80	0.70	0.694	18	0.43	<1	<3	8	91	6	96
9/4/81										3	<2	20	210	44	83
22/4/81	2.4	0.50	0.6	0.35	6.5	0.05	0.720	17.1	1.00	<1	<2	12	210	28	60
6/5/81	2.2	0.45	0.6	0.45	7.0	0.40	0.385	28.7	0.68	<1	<2	8	370	40	33
28/7/81	4.8	1.25	1.2	0.45	7.5	0.80	0.430	21.1	0.38	3	<1	3	67	8	90
1/9/81	5.8	1.45	1.4	0.60	9.5	0.50	0.460	34.6	0.60	2	<1	4	540	50	1260
East Baldhead River															
9/10/80	2.8	0.60	0.5	0.30	7.0	0.30	0.275	22	0.35	<1	<2	2	79	6	34
25/3/81	3.4	0.75	0.8	0.35	7.5	0.35	0.449	13	0.39	<1	<3	21	96	6	90
9/4/81										2	<2	8	120	-	47
22/4/81	2.5	0.45	0.5	0.25	6.5	0.20	0.500	14.4	0.60	<1	<2	8	140	14	50
6/5/81	2.4	0.40	0.5	0.30	6.5	0.20	0.360	14.8	0.70	<1	<2	7	180	18	60
28/7/81	3.0	0.60	0.5	0.35	6.0	0.30	0.225	12.1	0.32	0	<0.5	2	35	10	40
1/9/81	3.8	0.75	0.7	0.40	6.5	0.30	0.310	18.4	0.52	<1	<1	3	88	22	50
Harmony River															
24/3/81	4.8	1.05	1.5	0.30	7.5	1.95	0.563	23	0.92	<1	<3	4	120	7	190
22/4/81	3.2	0.65	1.0	0.30	7.0	0.90	0.455	17.5	1.80	2	<2	3	110	10	80
Magpie River															
24/3/81	20.0	4.10	1.2	0.80	25.5	1.50	0.277	25	0.75	<1	<3	6	67	83	250
Michipicoten River															
24/3/81	11.0	2.25	1.0	0.60	11.0	0.50	0.154	25	0.41	<1	<3	3	34	18	130
22/4/81	5.4	1.10	0.8	0.55	9.0	0.55	0.260	35	1.60	<1	<2	1	110	14	100
Montreal River															
24/3/81	8.8	2.05	1.1	0.55	8.0	0.45	0.173	65	0.55	<1	<3	3	86	22	300
22/4/81	5.6	1.20	0.8	0.50	7.0	0.45	0.330	36	1.20	<1	<2	4	140	30	190
28/7/81	5.6	1.25	0.6	0.55	7.0	0.30	0.190	56	0.38	0	<0.5	2	96	26	130
1/9/81	6.6	1.55	1.0	0.60	7.5	0.30	0.195	47	0.70	2	1	4	86	20	150
Old Woman River															
9/10/80	7 0	1.55	1.6	0.60	9.5	1.85	0.199	34	0.40	2	<2	<1	57	7	66
25/3/81	8 0	1.90	1.9	0.70	9.5	2.35	0.408	21	0.36	<1	<3	<3	54	6	81
9/4/81										2	<2	4	120	10	110
22/4/81	4.8	1.05	1.2	0.50	9.0	1.00	0.295	28	1.00	<1	<2	2	130	14	100
6/5/81	4.6	0.80	0.9	0.55	9.0	0.75	0.185	38	1.50	<1	<2	3	29C	20	300
28/7/81	8.8	1.90	2.1	0.75	8.5	3.10	0.205	20	0.52	1	<0.5	1	47	8	50
1/9/81	9.8	2.05	2.6	0.80	7.5	3.75	0.230	13	0.50	1	<1	<1	45	8	60

TABLE A2 (continued)

WATERCOURSE (Sampling Date)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO_4 (mg/L)	Cl (mg/L)	NO_3 (mg/L)	Colour (Hazen)	Turb. (Formazin)	Cu (ug/L)	Ni (ug/L)	Zn (ug/L)	Al (ug/L)	Mn (ug/L)	Fe (ug/L)
Old Woman Tributary #1															
9/10/81	7.0	1.20	1.2	0.45	12.0	0.40	0.259	20	0.25	6	<2	<1	110	4	31
22/4/81	4.8	0.85	0.7	0.40	10.0	0.30	0.220	18.4	0.38	<1	<2	<1	110	4	20
6/5/81	5.4	0.85	0.5	0.50	10.5	0.30	0.115	39.1	0.60	<1	<2	<1	140	14	40
28/7/81	6.6	1.10	0.9	0.40	10.0	0.35	0.305	6.7	0.25	1	<0.5	1	61	4	<10
1/9/81	6.8	1.05	1.2	0.45	10.0	0.25	0.275	7.2	0.18	1	1	<1	77	4	10
Old Woman Tributary #2															
9/10/80	8.4	1.55	1.0	0.60	12.0	0.70	0.315	23	0.15	<1	<2	<1	120	6	39
22/4/81	5.4	0.95	0.9	0.45	9.5	0.65	0.495	18.4	0.60	<1	<2	<1	120	6	20
6/5/81	4.6	0.60	0.5	0.60	10.0	0.35	0.340	31.0	0.50	<1	<2	1	150	12	30
28/7/81	10.2	2.00	1.4	0.80	10.0	1.25	0.315	9.4	0.26	0	<0.5	1	39	6	10
1/9/81	11.8	2.40	1.8	1.00	10.0	1.30	0.420	19.3	0.36	1	<1	<1	130	8	40
Old Woman Tributary #3															
9/10/80	6.4	1.25	2.2	0.70	10.5	2.45	0.228	36	0.40	2	<2	<1	110	24	130
Pancake River															
24/3/81	7.0	1.60	6.5	0.40	8.0	11.0	0.402	43	2.8	<1	<3	3	180	16	320
Sand River															
24/3/81	4.0	1.00	1.0	0.45	8.0	0.45	0.604	26	0.43	<1	<3	6	100	7	160
22/4/81	2.6	0.60	0.7	0.40	7.0	0.25	0.610	31	0.80	<1	<2	7	170	30	70
28/7/81	4.8	1.20	1.0	0.50	6.5	0.65	0.400	25.6	0.51	0	<0.5	1	70	24	130
1/9/81	5.0	1.35	1.2	0.45	6.5	0.55	0.355	15.7	0.32	3	1	2	110	18	120
South Baldhead River															
9/10/80	5.2	0.90	2.3	0.40	9.0	3.60	0.213	63	0.45	2	< 2	2	170	10	130
25/3/81	7.2	1.50	4.6	0.55	8.5	7.70	0.553	25	0.40	<1	< 3	8	86	17	170
9/4/81										3	< 2	21	120	23	86
22/4/81	3.2	0.55	2.1	0.35	7.0	2.95	0.520	27.9	0.70	<1	< 2	5	150	16	60
6/5/81	3.4	0.35	1.3	0.50	7.5	1.70	0.310	45.8	1.50	<1	< 2	7	160	30	100
28/7/81	7.4	1.40	5.0	0.55	7.0	9.15	9.195	37.3	0.41	0	0.5	4	69	24	110
1/9/81	9.2	1.70	7.5	0.65	8.0	14.50	0.170	18.4	0.64	2	1	1	190	36	250
Speckled Trout Creek															
9/10/80	3.4	0.90	1.1	0.35	8.5	0.85	0.364	16	0.37	< 1	< 2	< 1	90	24	80
25/3/81	3.4	0.85	1.5	0.40	7.5	1.30	0.599	12	0.28	< 1	< 3	7	100	12	46
9/4/81										2	< 2	12	260	51	76
22/4/81	2.4	0.55	0.9	0.30	6.5	0.55	0.535	10.7	1.50	< 1	< 2	8	240	34	40
6/5/81	1.6	0.40	0.6	0.30	6.0	0.30	0.275	22.9	1.00	< 1	< 2	7	200	42	80
28/7/81	5.0	1.35	1.7	0.50	7.0	1.50	0	4.0	0.29	0	< 0.5	1	34	12	40
1/9/81	5.4	1.45	1.8	0.55	7.0	1.20	0.625	7.2	0.31	< 1	< 1	< 1	36	14	100
Stokely Creek															
24/3/81	9.6	2.30	5.1	0.80	9.0	7.60	0.678	25	4.2	< 1	< 3	< 3	200	15	290

TABLE A3: Total invertebrate taxa lists from Lake Superior tributaries 1981

	Alona Creek June 22, 1981 Stations								Barrett River June 23, 1981 Stations								Coldwater River June 23, 1981 Stations								East Baldhead River June 26, 1981 Stations								South Baldhead River June 24, 1981 Stations					Speckled Trout Creek June 23, 1981 Stations							
	A	B	C	D	E	F	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D	A	B	C	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D
EPHEMEROPTERA														1																			3					1							
Baetidae																																													
Baetis	4			1	4	2			5	7	7	14	5	10	P	P	1		2	2	1			P	6	2	9	1	2	4		P	8	5	2	P			1		1		1	P	P
Cleoen									2																		1					P				P	P								
Pseudocleoen					5																						1	1				P	2	3	1										
Caenidae																																													
Caenis																																				P									
Ephemerellidae																																													
Ephemerella	1										1				P	P	2							P	4	2	2	5	2	4	P	P	1		1	P	P							P	P
Ephemeridae																																													
Ephemera																																	1			P									
Heptageniidae																																													
Epeorus	1	1							1	2	1					P							P								P		1												
Heptagenia	5	4			1							2		4	P	P							P	P		9	2		6	8			6				P								
Ironodes											1					P							P											1	1									P	
Rithrogena								P																																					
Stenacron																																				P									
Stenonema							P		2		1						1						P										2				P							P	P
Leptophlebidae																																													
Habrophlebia													1		P	P																P				P									
Paraleptophlebia																									22	4	22		7	1	P	P	10	1	12	P	P								
Siphlonuridae																																													
Siphlonurus																																				P									
Potamanthidae																																													
Potamanthus																																				P									
PLECOPTERA							P																															1							
Capniidae																																													
Allocapnia																P																				P								P	
Paracapnia																																					P								
Chloroperlidae																																													
Alloperla			1						2	2	1	2	1																										1					P	
Hastaperla																																									1			P	
Utaperla									2	1	2			1																															
Leuctridae																																													
Leuctra															P	P	1		1					P	2	1	1	3	1	2	P	P	1				P							P	P
Nemouridae																																													
Nemoura													1																																
Perlidae																																													
Acroneuria																							P								P		1	4	1		P								
Atoperla																															P														
Neoperla																																	1												
Paragnetina																																			3		P								
Perlodidae																																													
Isoperla													1		P	P																		1	1				2	1					
Pteronarcidae																																													
Pteronarcys																																												P	P
Taeniopterygidae																																													
Taenionema										2	2			1	P	P		1			1						1		3	1		P	2		1				2				2	P	

TABLE A3: Total invertebrate taxa lists from Lake Superior tributaries 1981

	Alona Creek June 22, 1981 Stations								Barrett River June 23, 1981 Stations								Coldwater River June 23, 1981 Stations								East Baldhead River June 26, 1981 Stations								South Baldhead River June 24, 1981 Stations					Speckled Trout Creek June 23, 1981 Stations							
	A	B	C	D	E	F	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D	A	B	C	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D
MEGALOPTERA																																													
Sialidae																																													
<u>Sialis</u>																													2																
DIPTERA														1																															
Blephoceridae	1	3				1		P								P							P																1						
Simuliidae	1	2			7		P		1	23	1		8	1		P						2	P	P									2	12	85		P		19	6				P	P
Tabanidae	1	2														P																												P	
Tendipedidae					2		P		2	4	11	8	1	17		P	7	2		2	2	1	P	P			7	2	2	3	P		4		5	P	P	2	3			1	9		
Tipulidae																									1																				
Pupa											1			1							1			P					2					1	1	P								P	
OLIGOCHAETA																																													
Lumbricoides					1	1																				2																			
Tubificidae	16	1	1		8	1			3			1	2		P			2			3	9					2	3	3	1		P		1		P				3	1				
HEMIPTERA																																													
Corixidae																																				P									
Gerridae																																													
<u>Gerris</u>															P	P							P																						
<u>Rheumatobates</u>																																P													
Vellidae																													1																
COLEOPTERA		1						P																												P									P
Chrysomellidae																																													
Dytiscidae																																P													
Elmidae																											2	1		1					2										
Gyrinidae																																				P									
Haliplidae																								P																					
Psephenidae												1		1													1		1						1										
OSTRACODA																P																P	2			P									
HIRUDINEA																																													
Erpobdellidae																																													
<u>Dina</u>												1	1			P																												P	
<u>COLLEMBOLA</u>																																													

TABLE A3: Total invertebrate taxa lists from Lake Superior tributaries 1981

Alona Creek — June 22, 1981 — Stations

Taxon	A	B	C	D	E	F	Q_U	Q_D
TRICHOPTERA								
Glossosomatidae								
Glossosoma		5	2					P
Hydropsychidae								
Cheumatopsyche		1						
Hydropsyche		1						
Lepidostomatidae								
Lepidostoma								
Leptoceridae								
Ceraclea								
Triaenodes								
Limnephilidae								
Hydatophylax								
Limnephilus								
Neophylax					1			
Psychoglypha								
Pycnopsyche								
Odontoceridae								
Psilotreta								
Philopotamidae								
Chimarra								
Dolophilodes		1						
Wormaldia								
Polycentropidae								
Neureclipses								
Polycentropus								
Rhyacophilidae								
Rhyacophila								
Pupa					1			
ANISOPTERA								
Aeshnidae								
Aeshna								
Boyeria								
Coroulegastridae								
Cordulegaster								
Gomphidae								
Gomphus								
Hagenius								
Lanthus								
Ophiogomphus								
ZYGOPTERA								
Agriidae								
Agrion								

Barrett River — June 23, 1981 — Stations

Taxon	A	B	C	D	E	F	Q_U	Q_D
TRICHOPTERA								
Glossosomatidae								
Glossosoma								
Hydropsychidae								
Cheumatopsyche								
Hydropsyche			1	1	1			P
Lepidostomatidae								
Lepidostoma								
Leptoceridae								
Ceraclea		1			1	1	P	P
Triaenodes								
Limnephilidae								
Hydatophylax							P	
Limnephilus							P	
Neophylax				1				
Psychoglypha								
Pycnopsyche						5		
Odontoceridae								
Psilotreta								
Philopotamidae								
Chimarra		1						
Dolophilodes		2		1				P
Wormaldia				1				
Polycentropidae								
Neureclipses								
Polycentropus				1				
Rhyacophilidae								
Rhyacophila								P
Pupa		1	1					
ANISOPTERA								
Aeshnidae								
Aeshna								
Boyeria								
Coroulegastridae								
Cordulegaster								
Gomphidae								
Gomphus								
Hagenius								
Lanthus								
Ophiogomphus								
ZYGOPTERA								
Agriidae								
Agrion								

Coldwater River — June 23, 1981 — Stations

Taxon	A	B	C	D	E	F	Q_U	Q_D
TRICHOPTERA								
Glossosomatidae								
Glossosoma							P	
Hydropsychidae								
Cheumatopsyche								
Hydropsyche			1				P	
Lepidostomatidae								
Lepidostoma								P
Leptoceridae								
Ceraclea								
Triaenodes								
Limnephilidae								
Hydatophylax								
Limnephilus								
Neophylax								
Psychoglypha								P
Pycnopsyche								P
Odontoceridae								
Psilotreta								
Philopotamidae								
Chimarra								
Dolophilodes				1			P	
Wormaldia							P	
Polycentropidae								
Neureclipses								
Polycentropus								
Rhyacophilidae								
Rhyacophila						1		
Pupa								
ANISOPTERA								
Aeshnidae								
Aeshna								
Boyeria								P
Coroulegastridae								
Cordulegaster								
Gomphidae								
Gomphus								
Hagenius								
Lanthus								
Ophiogomphus								
ZYGOPTERA								
Agriidae								
Agrion								

East Baldhead River — June 26, 1981 — Stations

Taxon	A	B	C	D	E	F	Q_U	Q_D
TRICHOPTERA								
Glossosomatidae								
Glossosoma								
Hydropsychidae								
Cheumatopsyche	2	3	1			1	P	
Hydropsyche	19		2				P	P
Lepidostomatidae								
Lepidostoma			2					
Leptoceridae								
Ceraclea								
Triaenodes								
Limnephilidae								
Hydatophylax								P
Limnephilus								
Neophylax								
Psychoglypha								
Pycnopsyche							P	
Odontoceridae								
Psilotreta		1						
Philopotamidae								
Chimarra								
Dolophilodes	5			1			P	P
Wormaldia							P	
Polycentropidae								
Neureclipses						1		
Polycentropus					1			
Rhyacophilidae								
Rhyacophila								
Pupa						1	P	
ANISOPTERA								
Aeshnidae								
Aeshna								
Boyeria							P	P
Coroulegastridae								
Cordulegaster			1					P
Gomphidae	5	5		2	5	3		
Gomphus								
Hagenius			1					
Lanthus								
Ophiogomphus			12					P
ZYGOPTERA								
Agriidae								P
Agrion								

South Baldhead River — June 24, 1981 — Stations

Taxon	A	B	C	Q_U	Q_D
TRICHOPTERA					
Glossosomatidae					
Glossosoma					
Hydropsychidae					
Cheumatopsyche	3	16	1		P
Hydropsyche		1	6		P
Lepidostomatidae					
Lepidostoma					
Leptoceridae					
Ceraclea			1	P	
Triaenodes				P	
Limnephilidae					
Hydatophylax				P	
Limnephilus					
Neophylax					
Psychoglypha					
Pycnopsyche					
Odontoceridae					
Psilotreta					P
Philopotamidae					
Chimarra	4	14	13		P
Dolophilodes	2	2	18		P
Wormaldia			16		P
Polycentropidae					
Neureclipses					
Polycentropus					
Rhyacophilidae					
Rhyacophila			7		
Pupa				P	
ANISOPTERA					
Aeshnidae					
Aeshna				P	P
Boyeria					
Coroulegastridae					
Cordulegaster				P	
Gomphidae			2		
Gomphus					
Hagenius					
Lanthus				P	
Ophiogomphus					
ZYGOPTERA					
Agriidae				P	
Agrion					

Speckled Trout Creek — June 23, 1981 — Stations

Taxon	A	B	C	D	E	F	Q_U	Q_D
TRICHOPTERA								
Glossosomatidae								
Glossosoma								
Hydropsychidae								
Cheumatopsyche								
Hydropsyche							P	
Lepidostomatidae								
Lepidostoma								P
Leptoceridae								
Ceraclea								
Triaenodes								
Limnephilidae								
Hydatophylax								
Limnephilus							P	
Neophylax								
Psychoglypha								
Pycnopsyche								P
Odontoceridae								
Psilotreta								
Philopotamidae								
Chimarra								
Dolophilodes								
Wormaldia								
Polycentropidae								
Neureclipses								
Polycentropus								
Rhyacophilidae								
Rhyacophila			1				P	
Pupa		1						
ANISOPTERA								
Aeshnidae								
Aeshna								
Boyeria								
Coroulegastridae								
Cordulegaster								P
Gomphidae								
Gomphus		1						
Hagenius								
Lanthus								
Ophiogomphus								
ZYGOPTERA								
Agriidae								
Agrion								

TABLE A3: Total invertebrate taxa lists from Lake Superior tributaries 1981

	Alona Creek June 22, 1981 Stations								Barrett River June 23, 1981 Stations								Coldwater River June 23, 1981 Stations							
	A	B	C	D	E	F	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D
ASTACIDAE																								
Cambarinae																								
Oronectes																								
PELYCOPODA																								
Sphaeridae																								
Piscidium																								
GASTROPODA																								
Physidae																								
Physa																								
SUB IMAGO (unidentified)		9	1			1		P								P								
PUPA (unidentified)			1			1											1					1		

	East Baldhead River June 26, 1981 Stations								South Baldhead River June 24, 1981 Stations					Speckled Trout Creek June 23, 1981 Stations							
	A	B	C	D	E	F	Q_U	Q_D	A	B	C	Q_U	Q_D	A	B	C	D	E	F	Q_U	Q_D
ASTACIDAE																					
Cambarinae																					
Oronectes									1												
PELYCOPODA																					
Sphaeridae																					
Piscidium												P									
GASTROPODA																					
Physidae																					
Physa												P									
SUB IMAGO (unidentified)	1	2									1										P
PUPA (unidentified)	1	1		1					2		1										

Stations A, B and C are downstream of Highway #17 and Stations D, E and F are upstream. Stations Q_U and Q_D are 1/2 hour qualitative grab samples upstream and downstream respectively, of Highway #17.